



Sulphur Recovery and Sulphur Emissions at Alberta Sour Gas Plants

Annual Report 2007

July 2008



ENERGY RESOURCES CONSERVATION BOARD

**ST101-2008: Sulphur Recovery and Sulphur Emissions at Alberta Sour Gas Plants for the 2007
Operating Year**

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640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Telephone: 403-297-8311
Fax: 403-297-7040
E-mail: ercb.info_services@ercb.ca

Web site: www.ercb.ca

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1 Introduction

The Energy Resources Conservation Board's (ERCB's) annual summary report on industry performance regarding sulphur recovery and sulphur emissions is published in accordance with *Interim Directive (ID) 2001-03: Sulphur Recovery Guidelines for the Province of Alberta* as part of its commitment to monitor the sulphur recovery of grandfathered¹ sour gas plants. This report covers both grandfathered sour gas plants (sulphur recovery and larger acid gas flaring sour gas plants) and nongrandfathered² sour gas plants (sulphur recovery and all acid gas injection sour gas plants). A complete list of the grandfathered and nongrandfathered plants is in Appendices 2.1 through 2.4.

While *ID 2001-03* did not change the recovery levels expected for new gas plants, it set out clear expectations on when older grandfathered plants are required to meet the same requirements as new plants. The ID incorporated a phased approach to the more stringent requirements and encouraged operators of sulphur recovery plants to take early action to improve performance. The ID allowed older plants that were reducing throughput by 7.5 per cent each year (and thus emissions) to continue to operate under their existing approvals until December 31, 2016, at which time grandfathering would end for all plants.

Grandfathered sulphur recovery plants that perform better than the minimum requirements specified in *ID 2001-03* have the option to file sulphur emission performance credit report forms and may use the credits to meet a portion of the sulphur recovery requirements at a future date (i.e., operate for a longer time or at a higher inlet rate before having to degrandfather the plant). All grandfathered sulphur recovery plants are taking advantage of the emission credit program, and credits are still increasing every year.

Acid gas flaring plants have no ability to earn credits and are subject to more stringent requirements over time.

In the last eight years a number of plants have degrandfathered:³ 15 plants have made upgrades to their plant, 12 plants have been relicensed to meet the requirements for new plants, and 7 plants have ceased operating. There are 26 grandfathered plants remaining. In addition, sulphur emissions have decreased substantially from 2000 to 2007 for both grandfathered acid gas flaring plants (emissions down 73 per cent) and grandfathered sulphur recovery plants (emissions down 40 per cent).

¹ Grandfathered plants are those that do not meet the sulphur recovery requirements for new plants listed in *ID 2001-03*. This includes some sulphur recovery plants and larger (sulphur inlet greater than 1 tonne per day [t/d]) acid gas flaring plants. All grandfathering will end by December 31, 2016.

² Nongrandfathered plants are those with an approved sulphur inlet greater than 1 t/d meeting the requirements for new plants, as listed in *ID 2001-03*. This includes both sulphur recovery plants and acid gas injection plants.

³ Degrandfathered plants are those that did not previously meet the requirements of *ID 2001-03* for new plants but have now been relicensed to meet the requirements for new plants, as set out in the ID.

2 Summary of Performance for Grandfathered Plants, 2000-2007

2.1 Grandfathered Plants That Have Been Degrandfathered

In the last eight years, 15 plants have made modifications to improve or install sulphur recovery to meet the more stringent sulphur recovery requirements for new plants. In addition, 12 other plants have been relicensed to meet these more stringent sulphur recovery requirements, and 7 grandfathered plants have shut down. Further details on these plants are provided in Appendix 1.

Plants that were degrandfathered in 2007 include

- 1) Gold Creek – CNRL
- 2) Rosevear (South) - Suncor
- 3) Spirit River - Bonavista
- 4) West Drumheller – Penn West (shut down)

As of December 2007, there were 16 grandfathered sulphur recovery plants and 10 grandfathered acid gas flaring plants remaining (see Appendix 2).

A detailed list of plants that have been degrandfathered in the last eight years is in Appendix 3, along with the process used for improving sulphur recovery.

2.2 Sulphur Emissions and Inlets at Grandfathered Plants, 2000-2007

An analysis of the sulphur emissions and sulphur inlet for the specific plants listed in *ID 2001-03* as grandfathered follows in Sections 2.2.1 and 2.2.2. For the purpose of this analysis, plants that have degrandfathered since *ID 2001-03* was issued are included with the grandfathered plants.

2.2.1 Sulphur Emissions Reduction

The grandfathered plants substantially reduced sulphur emissions from 2000 to 2007, as shown in Figure 1.

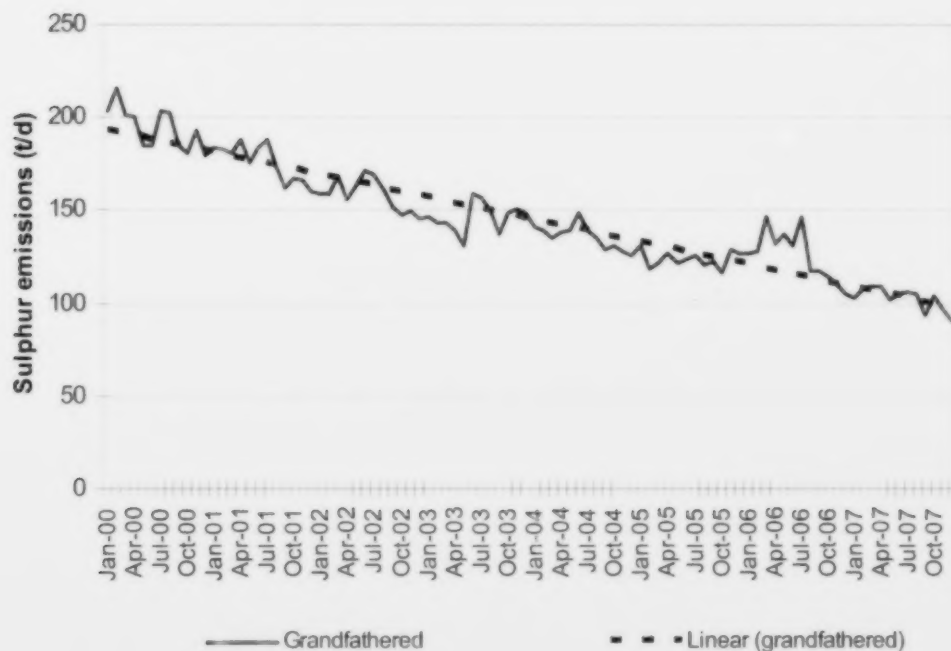


Figure 1. Sulphur emissions from grandfathered plants

The 47 per cent drop in emissions from grandfathered plants from the 2000 baseline year to 2007, shown in Figure 1, is due to a decrease of about 73 per cent in emissions from the grandfathered acid gas flaring plants and a decrease of about 40 per cent from the grandfathered sulphur recovery plants.

As can be seen in Figure 1, there was a significant decrease in emissions (about 18 per cent) from the grandfathered plants from 2006 to 2007. This decrease was due in large part to a decrease in throughput at Husky Strachan (Ram River) and improved sulphur recovery performance at Shell Waterton and Sencams Kaybob 3.

The 73 per cent decrease in emissions from grandfathered acid gas flaring plants from 2000 to 2007 was accompanied by a 33 per cent decrease in sulphur inlet. The decrease in emissions is due in part to acid gas injection facilities installed at Apache Virginia Hills (Hope Creek), Conoco Philips Vulcan (Long Coulee), Pengrowth Judy Creek, Harvest Operations Bellshill Lake, and Taylor Management Retlaw (Turin) and the

installation of sulphur recovery at Petro-Canada Wilson Creek. Between 2000 and 2007, 27 of the 28 grandfathered acid gas flaring plants showed emissions reductions.

The 40 per cent decrease in emissions from grandfathered sulphur recovery facilities from 2000 to 2007 was accompanied by a 20 per cent decline in sulphur inlet. The decrease in emissions is due in large part to plant modifications and/or improved operations at Semcams Kabob S. 3, BP Windfall, Shell Waterton, Keyera Brazeau, SemCAMS Kaybob S. 1 and 2, Shell Jumping Pound, and Shell Burnt Timber. Of the 28 grandfathered sulphur recovery plants, 25 reduced emissions, as shown in Appendix 4.1.

Appendix 4 lists sulphur production and emissions for each of the sulphur recovery plants for the years 2000 and 2007.

2.2.2 Decline in Sulphur Inlet

Improvements in operation and plant modifications have played a significant role in emission reductions at the grandfathered plants. As noted above, the reduction is also due to a 20 per cent decline in sulphur inlets of these plants from 2000 to 2007, as shown in Figure 2.

As also shown in Figure 2, there was about a 6 per cent decrease in sulphur inlet from the grandfathered plants from 2006 to 2007. This was primarily due to a decrease in throughput at two facilities, Husky Strachan (Ram River) and Shell Waterton. The decrease was offset in part by Keyera Strachan, which increased inlet.

Figure 2 shows the overall decline in sulphur inlets of grandfathered gas plants.

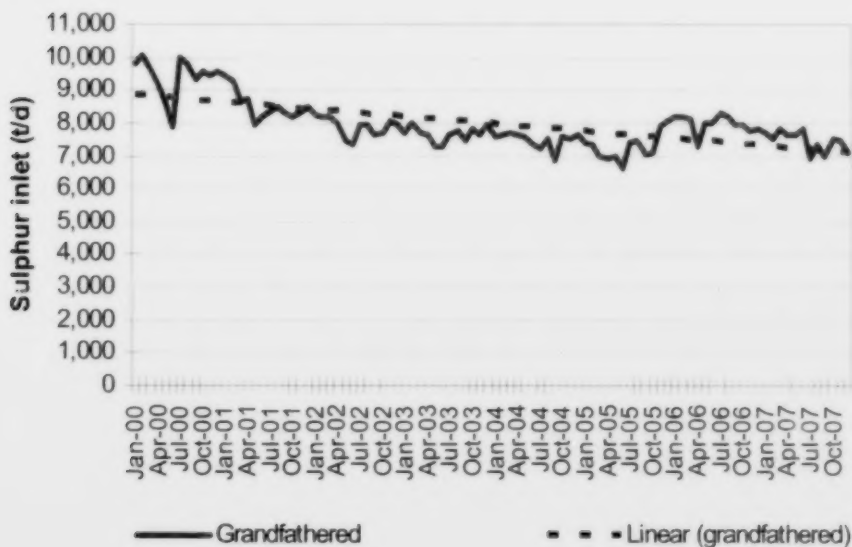


Figure 2. Sulphur inlet of grandfathered plants

2.3 Sulphur Emission Performance Credits

Sulphur emission performance credits (emission credits) can be earned by grandfathered sour gas plants with sulphur recovery that achieve recovery efficiencies higher than their required blended sulphur recovery efficiency. Credits may not be transferred between facilities and do not apply to acid gas flaring plants.

Credit reports can help an operator

- operate at higher sulphur inlets,
- meet the required blended sulphur recovery efficiency, and
- defer upgrading for a longer period of time.

Each sulphur emission credit represents 1 t of sulphur emissions that would have been emitted if the plant exactly met its minimum requirement. Credits must be earned before they can be used.

All plants that are able to file credit reports are doing so, and the emission credits are still increasing. As of the end of the fourth quarter of 2007, about 79 000 t of sulphur emission credits had been earned (see Figure 3 and Appendix 5). The total sulphur emissions from grandfathered sulphur recovery plants in 2007 was 34 000 t. Emission credits as of December 2007 equate to about 28 months of emissions from the grandfathered sulphur recovery plants.

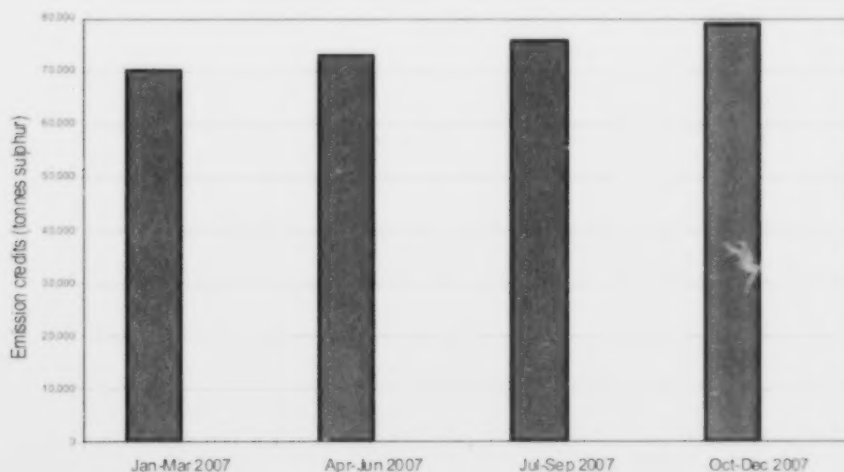


Figure 3. Net sulphur emission credits over time

Appendix 5 lists quarterly credits earned and cumulative credits for each of the grandfathered sulphur recovery plants in 2007.

3 Summary of Performance for Nongrandfathered Plants, 2000-2007

The ERCB also examined the sulphur emissions and sulphur inlet for each sour gas plant that had a sulphur inlet greater than 1 t/d and that met the requirements for new plants when *ID 2001-03* was issued.

The drop in sulphur emissions from these nongrandfathered plants was about 37 per cent between 2000 and 2007. The reduction in sulphur inlet was about 29 per cent over the same period. Details on these reductions on an individual plant basis for plants with sulphur recovery are given in Appendix 4.

4 Summary of Overall Performance for Grandfathered and Nongrandfathered Plants, 2000-2007

Examining sulphur inlet and sulphur emissions from both the grandfathered acid gas flaring and sulphur recovery facilities and nongrandfathered acid gas injection and sulphur recovery facilities reveals a 45 per cent drop in emissions from 2000 to 2007, together with a reduction in sulphur inlet of 25 per cent. From 2006 to 2007, emissions dropped about 17 per cent and sulphur inlet dropped about 8 per cent.

Appendix 1 Grandfathered Plants That Have Been Degrandfathered, 2000-2007

In the last eight years, 15 plants have made modifications to improve or install sulphur recovery to meet the more stringent sulphur recovery requirements for new plants in *ID 2001-03*. In addition, 12 other plants have been relicensed to meet these more stringent sulphur recovery requirements, and 7 grandfathered plants have shut down.

The 15 plants listed below had significant physical modifications to their plants to achieve higher sulphur recoveries.

Plants making modifications to meet the requirements for new plants

Plant name	Operator
1. Brazeau River	Keyera
2. Garrington (Olds)	Esprit
3. Homeglen (Rimbey)	Keyera
4. Bantry	AltaGas
5. Vulcan (Long Coulee)	Conoco Phillips
6. Wilson Creek	Petro-Canada
7. Rainbow	Husky
8. Edson	Talisman
9. Retlaw (Turin)	Taylor Management
10. Virginia Hills	Apache
11. Bellshill	Harvest Operations
12. Simonette	Suncor
13. Swan Hills South (Judy Creek)	Pengrowth
14. Kaybob S. 3	Semcams
15. South Rosevear	Suncor (2007 AGI)

Of the 12 plants listed below, 4 were relicensed to a higher sulphur recovery efficiency with existing equipment and/or minor modifications and 8 were relicensed to a lower throughput without modifications.

Plants relicensing to meet the requirements for new plants

Plant name	Operator
1. Okotoks (Mazeppa)	MPP
2. Crossfield East	Primewest
3. Sylvan Lake	NAL Resources
4. Sturgeon Lake	Kereco
5. Carson Creek	Pengrowth
6. Holmberg (Strome)	CNRL
7. Wilson Creek	Imperial
8. Strachan	Keyera
9. Big Bend	CNRL
10. Enchant	Taylor Management
11. Gold Creek	CNRL (2007)
12. Spirit River	Bonavista (2007)

Grandfathered plants that have ceased operating

Plant name	Operator
1. North Rosevear	Suncor
2. Bittern Lake	CNRL
3. North Caroline	BP Canada
4. South Caroline	BP Canada
5. Harmattan - Elkton	Bonavista
6. Leduc - Woodbend	Imperial
7. West Drummheller	Penn West (2007)

A detailed list of plants that have been degrandfathered in the last seven years is in Appendix 3, along with the process used for improving the sulphur recovery.

As of December 2007, there are 16 grandfathered sulphur recovery plants and 10 grandfathered acid gas flaring plants remaining (see Appendices 2.1 and 2.2).

Appendix 2.1. Grandfathered Sulphur Recovery (SR) Gas Plants							
			Guideline				
		Current Approved	Recovery for		Baseline		
		Sulphur Recovery	Approved	Approved	Capacity	Change in	
	Plant	Efficiency	Sulphur Inlet	S Inlet	1999 S Inlet	Status	
	Code	(%)	(%)	(t/d)	(t/d)	(from ID 2001-03)	
1	Brazeau R. - Keyera	1108	98.4	98.4	466.00	67.3	Degrandfathered in 2003; became AGI
2	Brazeau R. (Nordegg) - Keyera	1121	93.5	95.9	49.80	38.2	
3	Burnt Timber - Shell	1131	96.5	98.4	560.00	412.4	
4	Caroline (North) 1-11 - BP Canada	1374	69.7	69.7	5.00	5.0	Plant shut down in 2003
5	Caroline (South) 4-20 - BP Canada	1104	85.0	89.7	9.83	6.8	Plant shut down in 2003
6	Carstairs - Bonavista	1020	90.0	98.2	72.70*	9.5	
7	Crossfield (Balzac) - Nexen	1050	98.0	98.5	1,730.50	414.6	
8	Edson - Talisman	1084	98.4	98.4	350.00	220.9	Degrandfathered in 2003; upgraded SR
9	Gold Creek - CNRL	1129	95.9	95.9	49.90	64.1	Degrandfathered in 2007
10	Jumping Pound - Shell	1037	96.2	98.4	619.00	472.1	
11	Kaybob S. 1 & 2 - Semcams	1107	98.4	98.5	1,107.70	540.6	
12	Kaybob S. 3 - Semcams	1144	98.5	98.5	1,999.00	1,009.6	Degrandfathered in 2008, upgraded SR
13	Lone Pine Ck. - ExxonMobil	1139	98.0	98.3	165.40	129.5	
14	Minnehik B. L. - Penn West	1047	95.6	95.9	49.17	22.0	
15	Okotoks (Mazeppa) - MPP	1530	98.4	98.4	586.60	263.4	Degrandfathered in 2002
16	Redwater - ARC Resources	1028	Fluctuating	95.9	12.20*	3.1	
17	Rosevear (North) - Suncor	1206					Plant shut down; consolidation with 1268
18	Rosevear (South) - Suncor	1268	98.3	98.3	100.70	76.0	Degrandfathered in 2007; became AGI
19	Simonette - Suncor	1113	98.3	98.3	120.00	92.3	Degrandfathered in 2005, upgraded SR
20	Strachan (Ram River) - Husky	1141	98.1	99.5	4,660.50*	2,301.8	
21	Strachan - Keyera	1133	98.4	98.4	971.10	264.9	Degrandfathered in 2005
22	Sturgeon Lk. - Cadence	1112	95.9	95.9	49.81	40.6	Degrandfathered in 2005
23	Teepee - Talisman	1296	92.0	95.9	25.00	17.5	
24	Waterton - Shell	1056	98.7	99.5	3,148.00	2,099.6	
25	Wildcat Hills - Petro-Canada	1054	97.5	98.3	287.50	181.3	
26	Wimborne - Penn West	1081	95.5	98.3	235.00	182.1	
27	Windfall (West Whitecourt) - Semcams	1034	98.3	98.5	1,356.00	777.6	
28	Zama - Apache ¹	1219	92.0	98.2	80.30	38.6	Baseline revision 2001
* Annual average sulphur inlet.							
¹ As of October 2004, has been delivering acid gas to its Apache Zama AGI plant.							

Appendix 2.2. Grandfathered Acid Gas Flaring Plants							
			Guideline				
			Recovery for		Baseline		
			Approved	2007	Approved	Capacity	
	Plant	Sulphur Inlet	\$ Emissions	\$ Inlet	1999 \$ Inlet	Change in	
	Code	(%)	(t/d)	(t/d)	(t/d)	Status	
						(from ID 2001-03)	
1	Ansell (Galloway) - CNRL	1417	69.7	0.30	1.40	1.3	
2	Bantry - AltaGas	1114	69.7	0.36	2.00	1.0	Degrandfathered in 2002; became SR
3	Bellshill Lake - Harvest Operations	1280	89.7	0.02	5.77	3.8	Degrandfathered in 2005; became AGI
4	Big Bend - CNRL	1293	0	0.02	0.67	1.0	Degrandfathered in 2006
5	Bigoray - Penn West	1138	69.7	0.70	1.70	1.8	
6	Bittern Lake - CNRL	1124	69.7		2.48	1.0	Plant shut down in 2000
7	Boundary Lake S (Neptune) - Penn West	1202	69.7	0.84	1.63	1.1	
8	Boundary Lake S - Talisman	1024	69.7	0.31	1.90	1.0	
9	Carson Creek - Pengrowth	1062	0	0.17	0.83	1.0	Degrandfathered in 2004
10	Enchant - Taylor Management	1039	0	0.46	0.99	1.0	Degrandfathered in 2006
11	Forestburg - Signalta	1365	69.7	0.86	4.50	4.0	
12	Greencourt - CNRL	1127	69.7	0.65	1.00	1.3	
13	Harmattan-Elkton - Bonavista ¹	1083	0		0.53	1.0	Plant shut down; Operating as Comp.
14	Holmberg (Strome Holmberg) - CNRL	1179	0	0.27	0.61	1.6	Degrandfathered in 2005
15	Kaybob - Trilogy	1058	89.7	1.02	5.15	1.0	
16	Killam (Sedgewick) - AltaGas	1510	69.7	1.29	4.75	2.2	
17	Leduc - Woodbend - Imperial	1023	69.7		1.01	1.0	Plant shut down in 2006
18	Little Bow (Travers) - Bonavista	1150	69.7	0.52	1.50	1.2	
19	Retlaw (Turin) - Taylor Management	1191	69.7	0.03	4.64	1.7	Degrandfathered in 2004; became AGI
20	Spirit River - Bonavista	1560	0	0.61	0.99	1.0	Degrandfathered in 2007
21	Swan Hills South (Judy Creek) - Pengrowth	1069	69.7	0.07	3.75	2.7	Degrandfathered in 2006; became AGI
22	Sylvan Lake - NAL Resources	1070	0	0.21	0.75	1.0	Degrandfathered in 2002
23	Virginia Hills (Hope Creek) - Apache	1135	95.9	0.05	16.00	5.2	Degrandfathered in 2004; became AGI
24	Vulcan - ConocoPhillips	1100	69.7	0.01	4.90	2.7	Degrandfathered in 2002; became AGI
25	West Drumheller - Penn West	1109	69.7	0.00	2.99	1.1	Plant shut down in 2007
26	Whitescourt - Primewest	1115	89.7	1.73	7.50	3.5	
27	Wilson Creek - Imperial	1399	0	0.12	0.95	1.0	Degrandfathered in 2005
28	Wilson Creek - Petro-Canada	1096	85.0	0.12	4.70	2.3	Degrandfathered in 2001; became SR
¹ Now a dehydration and compressor unit.							

Appendix 2.3. Nongrandfathered Sulphur Recovery Plants				
		Current Approved Sulphur Recovery	Approved	
	Plant	Efficiency	S Inlet	
	Code	(%)	(t/d)	
1	Basing (Hanlan Robb) - Petro-Canada	1360	98.5	1,270.00
2	Bonnie Glen - Imperial ¹	1045	89.7	10.00
3	Brazeau R. - Blaze	1482	98.4	500.00
4	Brazeau R. (West Pembina) - ATCO Midstream	1458	98.4	520.00
5	Campbell-Namoo (Carbondale) - ATCO Midstream	1638	69.7	1.15*
6	Caroline - Shell	1662	99.5	5,445.00
7	Crossfield E. - Primewest	1079	38.4	863.82
8	Garrington (Olds) - Pengrowth	1021	98.4	404.90
9	Harmattan-Elkton - Taylor Processing	1060	98.3	82.70
10	Hays - CNRL	1585	90.0	9.90
11	Homeglen Rimbey - Keyera	1004	98.3	150.00
12	LaGlacé (Sexsmith) - EnCana	1892	98.4	483.10
13	Nevis - Spectra Energy Midstream	1002	98.4	300.00
14	Progress - CNRL	1506	96.0	49.50
15	Progress - Suncor	1629	69.7	2.51
16	Quirk Ck. - Imperial	1134	98.3	306.40*
17	Rainbow - AltaGas	1658	95.9	23.18
18	Rainbow - Husky ²	1105	98.3	213.49
19	Savanna Ck. (Coleman) - Devon	1051	98.6	800.00
20	Sinclair (Hythe Brainard) - EnCana	1147	98.3	127.80
21	Swalwell - Taqa North ³	1654	69.7	4.60
* Annual average sulphur inlet.				
¹ Started as an AGI facility in March 2007.				
² Started as an AGI facility in January 2002.				
³ Started as an AGI facility in August 2005.				

Appendix 2.4. Nongrandfathered Acid Gas Injection Plants Processing > 1t/d of Sulphur						
			Sulphur Recovery		2007	
			Equivalent	Approved	2007	
		Plant	Required	S Inlet	S Emissions	
					Sulphur	
					Injected	
Nongrandfathered acid gas injection plants		Code	(%)	(t/d)	(t/d)	
					(t/d)	
1	Acheson - Penn West	1628	69.7	4.65	0.03	2.82
2	Bigoray - Keyera	1357	98.2	64.00	0.27	35.96
3	Bistcho Lk - Paramount	1975	95.9	25.00	0.05	7.89
4	Boundary Lk S (Clear Hills) - CNRL	1880	95.9	19.21	0.00	11.34
5	Dizzy (Steen River) - JED Production	1738	95.9	34.40	0.00	1.66
6	Dunvegan - Devon	1169	89.7	9.90	0.01	0.37
7	Eaglesham (West Culp) - Devon	1775	95.9	17.20	0.00	0.39
8	Galahad (Hastings Coulee) - Husky	1690	89.7	10.90	0.01	2.10
9	Golden Spike - ATCO Midstream	1547	95.9	26.46	0.02	2.46
10	Gordondale - Spectra Energy Midstream	1668	98.2	54.31	0.04	25.43
11	Kelsey (Holmberg) - Sword	1244	69.7	3.07	0.02	0.63
12	Leduc-Woodbend (Calmar) - Mec Operating Co.	1676	95.9	15.50	0.01	3.89
13	Marlowe (Dizzy) - Bears paw	1765	95.9	20.90	0.00	0.51
14	Mitsue - Penn West ¹	1123	69.7	4.60	0.00	0.18
15	Mulligan (Fourth Creek) - Spectra Energy Midstream	1895	89.7	10.00	0.06	7.46
16	Normandville - Devon	1990	69.7	1.90	0.00	0.08
17	O'Chiese - ConocoPhillips	1970	95.9	14.53	0.01	0.63
18	Paddle River - Keyera	1089	69.7	1.50	0.00	0.46
19	Pembina - Keyera	1402	95.9	29.70*	0.02	8.81
20	Pembina - Imperial	1625	89.7	7.23	0.02	2.52
21	Pouce Coupe - Spectra Energy Midstream	1746	95.9	26.16	0.10	13.68
22	Provost (Hansman Lk) - Husky	1698	89.7	6.90	0.00	5.46
23	Provost (Thompson Lk) - Husky	1695	95.9	12.00	0.03	3.84
24	Puskwaskau - Devon	1964	89.7	5.15	0.00	0.12
25	Rainbow - ExxonMobil	1155	95.9	20.10*	0.04	5.55
26	Rycroft - Birchcliff	1793	95.9	21.00	0.00	3.85
27	Watelet (Wizard Lake) - ATCO Midstream	1672	69.7	3.30	0.00	0.40
28	Wayne-Rosedale - EnCana	1888	89.7	5.90*	0.02	1.16
29	Wembley - ConocoPhillips	1520	98.3	124.00	0.06	70.75
30	Zama - Apache	1878&1978	98.3	247.00	0.11	28.43
Grandfathered and nongrandfathered sulphur recovery or acid gas flaring plants that are now AGI facilities						
31	Bellshill Lake - Harvest Operations	1280	89.7	5.77	0.02	3.23
32	Bonnie Glen - Imperial	1045	89.7	10.00	0.06	4.86
33	Brazeau R. - Keyera	1108	98.4	466.00	0.60	241.97
34	Rainbow - Husky	1105	98.3	213.49	0.90	129.48
35	Retlaw (Turin) - Taylor Management	1191	69.7	4.64	0.03	2.12
36	Rosevear (South) - Suncor	1268	98.3	100.70	0.49	28.97
37	Swaiwell - Taqa North	1654	69.7	4.60	0.03	0.26
38	Swan Hills South (Judy Creek) - Pengrowth	1069	69.7	3.75	0.07	1.53
39	Virginia Hills (Hope Creek) - Apache	1135	95.9	16.00	0.05	7.43
40	Vulcan - ConocoPhillips	1100	69.7	4.90	0.01	1.14
* Annual average sulphur inlet.						
¹ Previously a nongrandfathered acid gas flaring plant that had emissions of less than 1 t/d and is now an AGI facility.						

Appendix 3. Plants That Have Been Degrandfathered

				Approved	
				S Inlet	Modification
Plants that have made modifications	Plant Code	Plant Name		(t/d)	Process
1	Plant Mods	1108	Brazeau R. - Keyera	400.00	(AGI)
2	Plant Mods	1021	Garrington (Olds) - Pengrowth	404.90	(SuperClaus)
3	Plant Mods	1004	Homeglen Rimbey - Keyera	150.00	(SuperClaus)
4	Plant Mods	1114	Bantry - AltaGas	2.00	(Xergy)
5	Plant Mods	1100	Vulcan - ConocoPhillips	4.90	(AGI)
6	Plant Mods	1096	Wilson Creek - Petro-Canada	4.70	(Claus)
7	Plant Mods	1105	Rainbow - Husky	213.50	(AGI)
8	Plant Mods	1084	Edson - Talisman	350.00	(SuperClaus)
9	Plant Mods	1191	Retlaw (Turin) - Taylor Management	4.64	(AGI)
10	Plant Mods	1135	Virginia Hills (Hope Creek) - Apache	16.00	(AGI)
11	Plant Mods	1280	Bellshill Lake - Harvest Operations	5.77	(AGI)
12	Plant Mods	1113	Simonette - Suncor	120.00	(SuperClaus)
13	Plant Mods	1069	Swan Hills South (Judy Creek) - Pengrowth	3.75	(AGI)
14	Plant Mods	1144	Kaybob S. 3 - Semcams	1999.00	(SuperClaus)
15	Plant Mods	1268	Rosevear (South) - Suncor	100.70	(AGI)
Plants that have been relicensed to higher sulphur recovery efficiency or lower sulphur inlets					
1	Relicensed	1530	Okotoks (Mazeppa) - MPP	586.60	
2	Relicensed	1079	Crossfield E. - Primewest	863.82	
3	Relicensed	1070	Sylvan Lake - NAL Resources	0.75	
4	Relicensed	1112	Sturgeon Lake - Cadence	49.81	
5	Relicensed	1062	Carson Creek - Pengrowth	0.83	
6	Relicensed	1179	Holmberg (Strome Holmberg) - CNRL	0.61	
7	Relicensed	1399	Wilson Creek - Imperial	0.95	
8	Relicensed	1133	Strachan - Keyera	971.10	
9	Relicensed	1293	Big Bend - CNRL	0.67	
10	Relicensed	1039	Enchant - Taylor Management	0.99	
11	Relicensed	1129	Gold Creek - CNRL	49.90	
12	Relicensed	1560	Spirit River - Bonavista	0.99	

Appendix 4.1. Gas Plants with Sulphur Recovery, Year 2007 Minus Year 2000

			Change in production and emissions year 2007 minus year 2000	
Plant			2007-2000	2007-2000
Code	Field-Licence		S Production (t/y)	S Emissions (t/y)
Grandfathered plants (in 2001)				
1	1144	Kaybob S. 3 - Sencams	(89,001.1)	(4,462.9)
2	1034	Windfall (West Whitecourt) - Sencams	(190,590.2)	(3,377.1)
3	1056	Waterton - Shell	(205,285.1)	(3,096.6)
4	1108	Brazeau R. - Keyera	(35,158.5)	(1,931.9)
5	1107	Kaybob S. 1 & 2 - Sencams	(153,031.9)	(1,780.6)
6	1037	Jumping Pound - Shell	43,723.9	(1,743.5)
7	1131	Burnt Timber - Shell	(21,538.3)	(1,295.1)
8	1050	Crossfield (Balzac) - Nexen	(53,605.1)	(849.0)
9	1081	Wimbome - Penn West	(25,536.6)	(802.4)
10	1219	Zama - Apache	(14,405.1)	(583.2)
11	1113	Simoneffe - Suncor	(7,031.1)	(509.7)
12	1206	Rosevear (North) - Suncor	(12,290.7)	(499.6)
13	1054	Wildcat Hills - Petro-Canada	(16,034.5)	(483.7)
14	1121	Brazeau R. (Nordegg) - Keyera	(7,481.3)	(395.0)
15	1104	Caroline (South) 4-20 - BP Canada	(2,186.0)	(349.5)
16	1112	Sturgeon Lk. - Cadence	(4,857.5)	(288.8)
17	1268	Rosevear (South) - Suncor	(16,220.1)	(279.8)
18	1530	Okotoks (Mazeppa) - MPP	(8,252.5)	(269.9)
19	1064	Edson - Talisman	13,927.5	(268.5)
20	1129	Gold Creek - CNRL	(13,233.2)	(261.3)
21	1139	Lone Pine Ck. - ExxonMobil	(13,564.0)	(181.6)
22	1047	Minnehik B. L. - Penn West	(4,067.0)	(173.7)
23	1020	Carstairs - Bonavista	(1,291.0)	(132.4)
24	1374	Caroline (North) 1-11 - BP Canada	(903.1)	(86.8)
25	1296	Teepee - Talisman	78.1	(70.9)
26	1028	Redwater - ARC Resources	(383.8)	19.6
27	1141	Strachan (Rim River) - Husky	(115,009.3)	519.2
28	1133	Strachan - Keyera	138,047.8	901.9
Totals			(815,179.6)	(22,732.8)
Grandfathered plants that were previously acid gas flaring and are now sulphur recovery				
1	1096	Wilson Creek - Petro-Canada	377.4	(994.1)
2	1114	Bantry - AltaGas	236.1	(178.9)
Totals			613.5	(1,173.0)
Nongrandfathered plants (plants meeting the requirements for new plants)				
1	1079	Crossfield E. - Primewest	(82,673.0)	(2,261.5)
2	1662	Caroline - Shell	(719,705.8)	(1,145.9)
3	1021	Garrington (Olds) - Pengrowth	(8,483.0)	(1,016.1)
4	1004	Homeglen Rimbey - Keyera	(4,849.5)	(900.5)
5	1360	Basing (Hanlan Robb) - Petro-Canada	(63,841.1)	(800.9)
6	1105	Rainbow - Husky	(22,351.5)	(793.8)
7	1458	Brazeau R. (West Pembina) - ATCO Midstream	16,098.4	(245.0)
8	1002	Nevis - Spectra Energy Midstream	(21,589.8)	(228.1)
9	1134	Quirk Ck. - Imperial	(40,880.0)	(224.9)
10	1654	Swatwell - Taqa North	(533.4)	(128.0)
11	1045	Bonnie Glen - Imperial	(2,499.7)	(104.7)
12	1060	Harmattan - Taylor Processing	(6,461.8)	(99.3)
13	1051	Savanna Ck. (Coleman) - Devon	(9,225.4)	(79.8)
14	1585	Hays - CNRL	(577.3)	(54.4)
15	1147	Sinclair (Hythe Brainard) - EnCana	(4,880.3)	(10.0)
16	1638	Campbell-Namoo (Carbondale) - ATCO Midstream	(327.5)	(0.2)
17	1629	Progress - Suncor	15.0	-
18	1658	Rainbow - AltaGas	2,509.9	42.1
19	1506	Progress - CNRL	5,189.2	48.4
20	1892	La Glace (Sexsmith) - EnCana	(3,908.1)	234.0
21	1482	Brazeau R. - Blaze	18,085.7	302.0
Totals			(950,889.1)	(7,466.6)
Grand totals			(1,765,455.1)	(31,372.4)

Appendix 4.2. Gas Plants with Sulphur Recovery, Year 2000

Plant	Code	Field-Licensee	Total	Total Annual	Actual	Current	Total Annual
			Inlet	Emissions	Sulphur Recovery Effic.	Approved Sulphur Recovery Effic.	Production
			(t/y)	(t/y)	(%)	(%)	(t/y)
Grandfathered plants (in 2001)							
1	1144	Kaybob S. 3 - Semcams	360,565.8	6,646.1	98.2%	98.1	369,708.4
2	1034	Windfall (West Whitecourt) - Semcams	286,311.3	4,616.6	98.4%	98.3	292,237.0
3	1056	Waterton - Shell	671,377.4	6,233.1	99.1%	98.7	679,224.2
4	1108	Brazeau R. - Keyera	36,697.0	2,152.6	94.2%	92.1	35,158.5
5	1107	Kaybob S. 1 & 2 - Semcams	234,341.8	2,756.9	98.9%	98.4	250,134.3
6	1037	Jumping Pound - Shell	161,744.1	5,509.7	96.6%	96.2	158,522.1
7	1131	Burnt Timber - Shell	156,959.7	4,844.0	96.9%	96.5	152,115.5
8	1050	Crossfield (Balzac) - Nexen	144,323.2	2,408.8	98.3%	98.0	141,245.3
9	1081	Wimbome - Penn West	57,618.0	1,833.9	96.7%	95.5	54,008.0
10	1219	Zama - Apache	15,117.5	583.9	96.1%	92.0	14,405.1
11	1113	Simonette - Suncor	32,358.2	793.8	97.5%	96.5	31,239.2
12	1206	Rosevear (North) - Suncor	10,771.6	499.6	96.1%	94.6	12,290.7
13	1054	Wildcat Hills - Petro-Canada	71,413.7	1,220.0	98.2%	97.5	66,931.2
14	1121	Brazeau R. (Nordegg) - Keyera	12,991.3	727.9	94.6%	93.5	12,842.1
15	1104	Caroline (South) 4-20 - BP Canada	2,483.7	349.5	86.2%	85.0	2,186.0
16	1112	Sturgeon Lk. - Cadence	18,698.9	729.2	96.2%	94.0	18,456.1
17	1268	Rosevear (South) - Suncor	16,104.4	457.5	97.6%	95.6	16,426.7
18	1530	Okotoks (Mazeppa) - MPP	95,120.2	1,260.7	98.7%	98.3	95,760.9
19	1084	Edson - Talisman	73,009.3	1,421.2	98.1%	97.9	73,337.4
20	1129	Gold Creek - CNRL	20,071.4	514.9	97.6%	97.0	20,883.0
21	1139	Lone Pine Ck. - ExxonMobil	38,390.2	599.7	98.4%	96.0	37,232.3
22	1047	Minnehik B. L. - Penn West	7,018.8	270.4	96.1%	95.6	6,748.4
23	1020	Carstairs - Bonavista	3,815.5	324.6	91.2%	90.0	3,370.0
24	1374	Caroline (North) 1-11 - BP Canada	1,039.2	86.8	91.2%	89.7	903.1
25	1296	Teepee - Talisman	5,424.7	372.2	93.2%	92.0	5,070.9
26	1028	Redwater - ARC Resources	1,184.9	88.3	92.7%	Fluctuating	1,118.3
27	1141	Strachan (Ram River) - Husky	791,052.9	7,877.7	99.0%	98.1	781,009.3
28	1133	Strachan - Keyera	97,769.5	1,169.6	98.8%	98.1	97,129.6
Totals			3,423,774.2	56,349.2	98.4%		3,431,693.7
Grandfathered plants that were previously acid gas flaring and are now sulphur recovery							
1	1096	Wilson Creek - Petro-Canada	908.0	1,036.4	0.0%	-	-
2	1114	Bantry - AltaGas	310.6	310.7	0.0%	-	-
Totals			1,218.5	1,347.1	0.0%		-
Nongrandfathered plants (plants meeting the requirements for new plants)							
1	1079	Crossfield E. - Primewest	170,668.1	3,028.6	98.2%	98.0	169,921.2
2	1662	Caroline - Shell	1,833,270.9	2,458.5	99.9%	99.8	1,844,827.3
3	1021	Garrington (Olds) - Pengrowth	103,220.0	2,152.2	97.9%	97.1	101,783.0
4	1004	Homeglen Rimbey - Keyera	19,957.4	1,003.0	94.8%	92.0	18,208.7
5	1360	Basing (Hanlan Robb) - Petro-Canada	299,824.2	3,434.8	98.8%	98.5	288,911.9
6	1105	Rainbow - Husky	25,910.0	1,123.5	95.2%	95.0	22,351.5
7	1458	Brazeau R. (West Pembina) - ATCO Midstream	107,983.1	1,624.1	98.6%	98.4	112,615.2
8	1002	Nevis - Spectra Energy Midstream	37,590.7	467.5	98.8%	98.4	37,091.6
9	1134	Quirk Ck. - Imperial	86,771.0	1,002.1	98.9%	98.3	90,372.6
10	1654	Swallow - Taqa North	517.6	138.9	79.3%	70.0	533.4
11	1045	Bonnie Glen - Imperial	3,281.6	125.8	96.1%	95.9	3,062.0
12	1060	Harmattan - Taylor Processing	11,515.1	164.6	98.6%	98.6	11,875.6
13	1051	Savanna Ck. (Coleman) - Devon	137,197.0	1,369.9	99.0%	98.6	136,352.7
14	1585	Hays - CNRL	2,380.2	129.0	94.5%	90.0	2,217.5
15	1147	Sinclair (Hythe Brainerd) - EnCana	28,431.8	266.2	99.0%	98.3	28,291.8
16	1638	Campbell-Namao (Carbondale) - ATCO Midstream	364.59	0.2	100.0%	69.7	403.7
17	1629	Progress - Suncor	389.10	-	100.0%	69.7	336.7
18	1658	Rainbow - AltaGas	1,882.0	127.9	92.6%	70.0	1,597.4
19	1506	Progress - CNRL	9,215.7	237.8	97.4%	96.5	9,060.8
20	1892	La Glace (Sexsmith) - EnCana	125,906.9	1,292.3	99.0%	98.4	126,382.7
21	1482	Brazeau R. - Blaze	97,601.0	917.1	99.1%	98.4	96,505.4
Totals			3,103,888.0	21,094.0	99.3%		3,102,702.9
Grand totals			6,528,880.7	78,790.3	98.8%		6,534,396.6

Appendix 4.3. Gas Plants with Sulphur Recovery, Year 2007

		Total	Total Annual	Annual Sulphur	Current	Total Actual
Plant		Inlet	Emissions	Recovery	Approved Sulphur Recovery Effic.	Production
Code	Field-Licensee	(t/y)	(t/y)	(%)	(%)	(t/y)
Grandfathered plants (in 2001)						
1	1144 Kaybob S. 3 - Semcams	274,584.1	2,183.2	99.2%	98.5%	280,707.3
2	1034 Windfall (West Whitecourt) - Semcams	99,245.2	1,239.5	98.8%	98.3%	101,646.8
3	1056 Waterton - Shell	471,343.5	3,136.5	99.3%	98.7%	473,939.1
4	1108 Brazeau R. - Keyera	88,490.7	220.7	99.8%	98.4%	Injected (88,318.0)
5	1107 Kaybob S. 1 & 2 - Semcams	98,048.9	976.3	99.0%	98.4%	97,102.4
6	1037 Jumping Pound - Shell	200,971.1	3,766.2	98.2%	96.2%	202,246.0
7	1131 Burnt Timber - Shell	129,001.7	3,548.9	97.4%	96.5%	130,577.2
8	1050 Crossfield (Baizac) - Nexen	90,927.2	1,559.8	98.3%	98.0%	87,640.2
9	1081 Wimbome - Penn West	29,388.6	1,031.6	96.5%	95.5%	28,471.5
10	1219 Zama - Apache ¹	3,264.6	0.7	100.0%	92.0%	Injected (3,425.2)
11	1113 Simonette - Suncor	24,424.5	284.1	98.8%	98.3%	24,208.1
12	1206 Rosevear (North) - Suncor	-	-	0.0%	94.6%	-
13	1054 Wildcat Hills - Petro-Canada	52,985.5	736.3	98.6%	97.5%	50,896.7
14	1121 Brazeau R. (Nordegg) - Keyera	5,717.7	332.9	94.2%	93.5%	5,360.8
15	1104 Caroline (South) 4-20 - BP Canada	-	-	0.0%	69.7%	-
16	1112 Sturgeon Lk. - Cadence	13,941.1	440.4	96.9%	95.9%	13,598.6
17	1268 Rosevear (South) - Suncor ²	12,717.4	177.8	98.6%	98.3%	2,206.6
18	1530 Okotoks (Mazeppa) - MPP	86,680.4	990.8	98.9%	98.4%	87,508.4
19	1084 Edson - Talisman	89,814.5	1,152.7	98.7%	98.4%	87,264.9
20	1129 Gold Creek - CNRL	7,887.3	253.6	98.8%	95.9%	7,649.8
21	1139 Lone Pine Ck. - ExxonMobil	23,587.4	418.1	98.3%	98.0%	23,668.3
22	1047 Minnehik B. L. - Penn West	2,845.5	96.7	96.5%	95.6%	2,681.4
23	1020 Carstairs - Bonavista	2,286.7	192.2	91.5%	90.0%	2,079.0
24	1374 Caroline (North) 1-11 - BP Canada	-	-	0.0%	85.0%	-
25	1296 Teepee - Talisman	5,436.0	301.3	94.5%	92.0%	5,149.0
26	1028 Redwater - ARC Resources	815.0	107.9	87.2%	Fluctuating	734.6
27	1141 Strachan (Ram River) - Husky	673,094.2	8,396.9	98.8%	98.1%	666,000.0
28	1133 Strachan - Keyera	237,607.0	2,071.5	99.1%	98.4%	235,177.4
Totals		2,725,125.68	33,616.42	98.7%		2,816,514.10
¹ Operated as an acid gas injection plant, delivering acid gas to Apache Zama injection facility.						
² Began operating as an acid gas injection plant in March 2007. Injected 10,574.3 t of sulphur in 2007.						
Grandfathered plants that were previously acid gas flaring and are now sulphur recovery						
1	1096 Wilson Creek - Petro-Canada	456.2	42.3	89.9%	85.0%	377.4
2	1114 Bantry - AltaGas	389.0	131.8	64.2%	69.7%	236.1
Totals		845.2	174.1	77.9%		613.5
Nongrandfathered plants (plants meeting the requirements for new plants in 2001)						
1	1079 Crossfield E. - Primewest	89,268.7	767.1	99.1%	98.4%	87,248.2
2	1662 Caroline - Shell	1,116,959.6	1,312.6	99.9%	99.5%	1,125,121.5
3	1021 Garrington (Oids) - Pengrowth	91,246.0	1,136.1	98.8%	98.4%	93,300.0
4	1004 Homeglen Rimbey - Keyera	12,485.4	102.5	99.2%	98.3%	13,359.2
5	1360 Basing (Hanlan Robb) - Petro-Canada	227,838.9	2,633.9	98.5%	98.5%	225,070.8
6	1105 Rainbow - Husky	41,767.1	329.7	99.3%	98.3%	Injected (47,260.1)
7	1458 Brazeau R. (West Pembina) - ATCO Midstream	125,495.8	1,379.1	98.9%	98.4%	128,713.6
8	1002 Nevis - Spectra Energy Midstream	16,147.6	239.4	98.5%	98.4%	15,502.0
9	1134 Quirk Ck. - Imperial	46,227.2	777.2	98.5%	98.3%	49,492.6
10	1654 Swahwell - Taqa North	105.6	10.9	89.7%	69.7%	Injected (94.6)
11	1045 Bonnie Glen - Imperial ³	2,270.6	21.1	99.1%	89.7%	862.3
12	1060 Harrold - Taylor Processing	5,151.1	65.3	98.8%	95.9%	5,413.8
13	1051 Savanna Ck. (Coleman) - Devon	125,812.8	1,290.1	99.0%	98.6%	127,127.3
14	1585 Hays - CNRL	1,738.8	74.6	95.7%	90.0%	1,640.2
15	1147 Sinclair (Hythe Brainard) - EnCana	23,592.1	286.2	98.8%	98.3%	23,411.5
16	1638 Campbell-Namao (Carbondale) - ATCO Midstream	75.5	0.0	100.0%	69.7%	76.2
17	1629 Progress - Suncor	393.7	0.0	100.0%	69.7%	351.7
18	1658 Rainbow - AltaGas	4,232.2	170.0	98.0%	95.9%	4,107.3
19	1506 Progress - CNRL	15,473.0	286.2	98.0%	96.0%	14,250.0
20	1892 La Glace (Sexsmith) - EnCana	124,115.0	1,526.3	98.8%	98.4%	122,474.6
21	1482 Brazeau R. - Blaze	109,774.2	1,219.1	98.9%	98.4%	114,591.1
Totals		2,180,170.8	13,627.38	99.4%		2,151,813.85
³ Began operating as an acid gas injection plant in March 2007. Injected 1,775.3 t of sulphur in 2007.						
Grand totals		4,906,141.6	47,417.9	99.0%		4,768,941.4

Appendix 5. Sulphur Credits Earned										
Grandfathered sulphur recovery gas plants		Credits				Cumulative Credits				Status
		Jan-Mar 2007	Apr-Jun 2007	Jul-Sep 2007	Oct-Dec 2007	Jan-Mar 2007	Apr-Jun 2007	Jul-Sep 2007	Oct-Dec 2007	
Plant Code										
1	1108	Brazeau R. - Keyera				-	-	-	-	Degradfathered
2	1121	Brazeau R. (Nordegg) - Keyera	1.2	11.2	9.0	15.6	639.4	650.7	659.6	675.2
3	1131	Burnt Timber - Shell	13.6	39.7	113.6	294.5	943.0	982.7	1096.3	1390.8
4	1374	Caroline (North) 1-11 - BP Canada					-	-	-	- Plant shut down
5	1104	Caroline (South) 4-20 - BP Canada					-	-	-	- Plant shut down
6	1020	Carstairs - Bonavista	-20.2	22.3	18.1	15.0	215.0	237.2	255.3	270.3
7	1050	Crossfield (Balzac) - Nexen	80.6	51.3	-56.6	162.6	1,912.9	1964.2	1907.6	2070.2
8	1084	Edson - Talisman					122.2	122.2	122.2	122.2 Degradfathered
9	1129	Gold Creek - CNRL	-1.9	-4.0			193.6	189.5	189.5	189.5 Degradfathered
10	1037	Jumping Pound - Shell	531.2	497.0	408.7	494.3	6,049.8	6546.8	6955.5	7449.8
11	1107	Kaybob S. 1 & 2 - Cams Midstream Services	172.4	140.2	139.1	141.0	3,184.9	3325.1	3464.2	3605.2
12	1144	Kaybob S. 3 - Semcams					3,213.9	3213.9	3213.9	3213.9 Degradfathered
13	1139	Lone Pine Ck. - ExxonMobil	5.5	23.7	-16.9	50.7	262.6	286.3	269.4	320.1
14	1047	Minnehik B. L. - Penn West	6.8	7.2	3.4	8.7	96.4	103.6	107.0	115.7
15	1530	Okotoks - MPP					-	-	-	- Degradfathered
16	1028	Redwater - Imperial	34.8	34.3	15.6	35.0	397.4	431.7	447.4	482.4 Variable inlet rate
17	1206	Rosevear (North) - Suncor ¹					-	-	-	- Plant shut down
18	1268	Rosevear (South) - Suncor ¹	4.7				1,634.7	1634.7	1634.7	1634.7 Degradfathered
19	1113	Simonette - Suncor					663.7	663.7	663.7	663.7 Degradfathered
20	1141	Strachan (Ram River) - Husky	793.7	798.9	1,298.9	930.1	28,085.1	28883.9	30182.8	31112.9
21	1133	Strachan - Keyera					1,229.7	1229.7	1229.7	1229.7 Degradfathered
22	1112	Sturgeon Lk. - Cadence					590.6	590.6	590.6	590.6 Degradfathered
23	1296	Teepee - Talisman	19.2	22.6	14.3	21.6	775.0	797.7	811.9	833.6
24	1056	Waterton - Shell	1,004.6	894.5	494.3	685.7	9,980.2	10874.7	11369.0	12054.7
25	1054	Wildcat Hills - Petro-Canada	120.9	124.1	110.4	123.5	2,411.9	2536.0	2646.4	2769.8
26	1081	Wimbome - Vault	78.9	67.4	72.6	76.5	1,799.4	1866.8	1939.4	2015.9
27	1034	Windfall (West Whitecourt) - Semcams	136.0	140.7	96.8	146.3	4,931.7	5072.4	5169.2	5315.5
28	1219	Zama - Apache ²	0	0	0	0	982.4	982.4	982.4	982.4 Delivers acid gas to its Apache Zama AGI plant as of October 2004
Totals						70,315.3	73,186.5	75,907.7	79,108.8	
¹ Plant consolidation.										
² Apache Zama - shipping acid gas to adjacent AGI gas plant.										

